(12) UK Patent Application (19) GB (11) 2 152 160 A

(43) Application published 31 Jul 1985

(21) Application No 8432038

(22) Date of filing 19 Dec 1984

(30) Priority data
(31) 8336986 (32) 23 Dec 1983 (33) DE

(71) Applicant
Fichtel & Sachs AG (FR Germany),
Ernst-Sachs-Strasse 62, D-8720 Schweinfurt, Federal Republic of Germany

(72) Inventor
Hans Joachim Schwerdhofer

(74) Agent and/or Address for Service
Matthews Haddan & Co,
Haddan House, 33 Elmfield Road, Bromley, Kent BR1 1SU

(51) INT CL⁴
F16D 41/30

(52) Domestic classification
F2C 1D11G2 1D4
U1S 1825 F2C

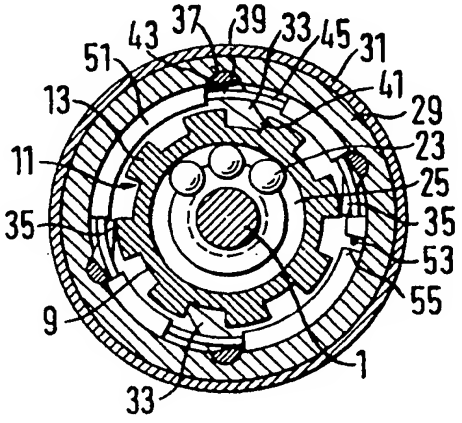
(56) Documents cited
GB 1232899 GB 0650373 GB 0300241
GB 0821823 GB 0462555 GB 0226376
GB 0739881

(58) Field of search
F2C

(54) Ratchet clutch

(57) The ratchet clutch comprises at least two pivotably mounted pawls 33,35 offset in angle in relation to one another about the rotation axis. The pawls are resiliently initially stressed in the direction of engagement with teeth 13. The angular intervals of the pawls 33 and 35 are made unequal to an integral multiple of the angular interval of the teeth of the ratchet toothing. In this way even when the ratchet toothing has a small number of teeth the idle motion of the ratchet freewheel in the transition from the freewheeling function to the driving function can be kept slight.

FIG. 3



GB 2 152 160 A

FIG. 1

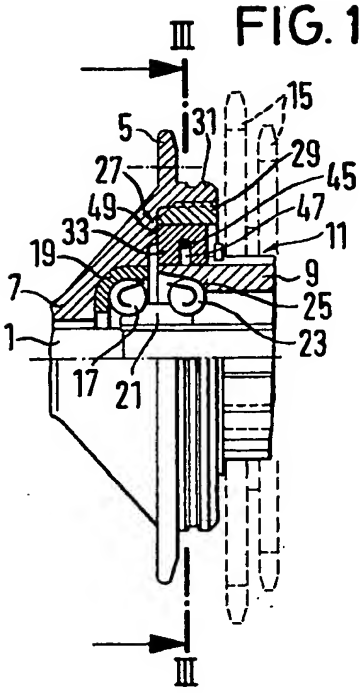


FIG. 2

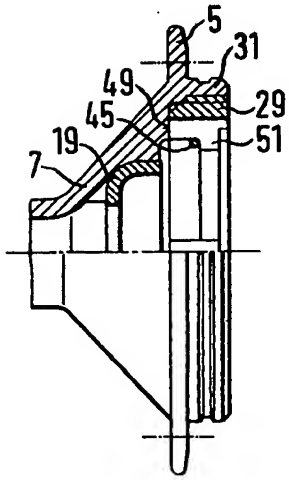


FIG. 3

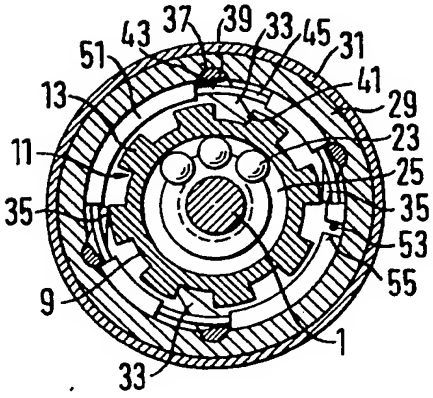


FIG. 6

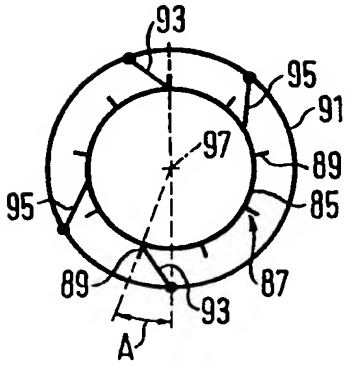


FIG. 4

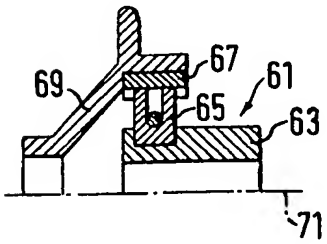
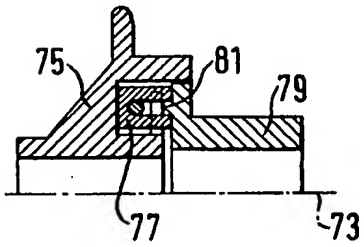


FIG. 5



SPECIFICATION

Ratchet drive arrangement

The invention relates to a ratchet drive arrangement, especially for cycle freewheel drive hubs.

A ratchet drive arrangement for a cycle freewheel drive hub is known from Fed. German Utility Model No. 82 28 602. The drive hub comprises a drive member carrying a set of chain wheels and mounted rotatably on a hub spindle, and a hub sleeve likewise rotatably mounted on the hub spindle and overlapping axially with the drive member. Two ratchet pawls arranged offset in angle by 180 degrees in relation to one another are mounted pivotably in a ring fixedly retained on the hub sleeve, which pawls either engage simultaneously in a ratchet toothing provided on the external circumference of the drive member or are simultaneously lifted out of the ratchet toothing by its teeth which are arranged at equal angular intervals from one another. The ratchet toothing extends substantially over the entire axial length of the drive member and serves at the same time for the rotation-fast retention of the set of chain wheels. For this reason the number of teeth of the ratchet toothing is relatively low, and a relatively great idle motion occurs in the engaging direction of the drive hub.

An object of the invention is to improve the ratchet drive arrangement so that even with a small number of teeth of its ratchet toothing, such as results especially when a chain wheel toothing of the drive member of a cycle drive hub is utilised, it has only a comparatively small idle motion in the driving direction of rotation.

The invention adopts the basis of a ratchet drive arrangement having two rotation units which are rotatable about a common axis of rotation either with or in relation to one another. A first rotation unit carries a ratchet toothing having a plurality of teeth arranged at equal angular intervals from one another on a circle enclosing the axis of rotation. At least two pawls arranged about the axis of rotation are pivotably mounted on the second rotation unit. The pawls are resiliently initially stressed in the direction of their engagement in the ratchet toothing and block the two rotation units against relative rotation in a first direction of rotation and liberate the rotation units for a relative rotation in the opposite direction. Now the invention consists in that at least two pawls are provided the angular interval of which is unequal to an integral multiple of the angular interval of the teeth of the ratchet toothing. Thus the pawls are not simultaneously in engagement, whereby however the idle motion of the two rotation units in the blocking first direction of relative rotation is reduced.

In a preferred form of embodiment the pawls are arranged by groups at equal angular intervals from one another. In this way it is possible to render symmetrical the forces to be transmitted between the two rotation units, so that the overloading of the bearings of the two rotation units by unilateral forces rotating about the rotation axis is avoided. At least two groups of pawls are provided which are angularly offset in the circumferential direction in relation to one another in such a way that the pawls of the one group are always lifted out of the ratchet toothing when the pawls of another group are engaging in the ratchet toothing.

In a preferred form of embodiment only two pairs of pawls are provided. The teeth of the pawl toothing are in even number and the pawls of each pair are offset in angle by 180 degrees in relation to one another, for the sake of symmetry. Thus the pawls of each pair either engage simultaneously in the ratchet toothing or are simultaneously lifted out of the ratchet toothing. The invention can also be utilised in the case of an odd number of teeth of the ratchet toothing, if alternatively the pawls of each pair are offset in relation to one another by 180 degrees plus or minus half the angular interval of the teeth. Furthermore the pawls of each pair are offset in angle in relation to the pawls of the other pair in each case substantially by an odd-numbered multiple of half the angular interval of the teeth of the pawl toothing.

The invention can be used with ratchet drive arrangements where the pawls are pivotable about pivot axes extending parallel to the axis of rotation of the rotation units as well as with drive arrangements where the pawls are pivotable about pivot axes extending radially of the axis of rotation of the rotation units.

Examples of embodiment of the invention are to be explained in greater detail below by reference to drawings, wherein:

FIGURE 1 shows a partial axial longitudinal section through a ratchet drive arrangement of a cycle freewheel drive hub;

FIGURE 2 shows a partial axial longitudinal section of a hub sleeve of the drive hub according to Figure 1;

FIGURE 3 shows an axial cross-section through the drive hub seen along a line III-III in Figure 1;

FIGURES 4 and 5 show diagrammatic illustrations of variants of a ratchet drive arrangement for cycle freewheel drive hubs;

FIGURE 6 shows a diagrammatic representation of a variant of the ratchet drive arrangement according to Figures 1 to 3.

The cycle freewheel drive hub according to Figures 1 to 3 comprises a hub spindle 1 for securing to the cycle frame and on which a hub sleeve 7 provided with spoke flanges 5 is rotatably mounted. A driver sleeve 9 is rotata-

bly mounted axially laterally of the hub sleeve 7 on the hub spindle 1. The driver sleeve 9 is provided on its external circumference with an external toothing 11 the teeth 13 of which extend substantially over the whole axial length of the driver sleeve 9. Several chain wheels 15 are held coaxially on the driver sleeve 9 and are connected fast in rotation with the driver sleeve 9 by means of a toothing on their internal circumference complementary to the toothing 11. The hub sleeve 7 and the driver sleeve 9 are each mounted on the hub spindle 1 by means of at least two rolling bearings, Figure 1 showing only the axially adjacent bearing positions. The rolling bearing on the driver side of the hub sleeve 7 comprises balls 17, a steel bearing shell 19 pressed into the hub sleeve 7 and a cone 21 seated on the hub spindle 1. The cone 21 is formed as a double cone and at the same time guides balls 23 of the rolling bearing on the hub sleeve side of the driver sleeve 9. The balls 23 moreover run in a track groove 25 of the driver sleeve 9.

The driver sleeve 9 is coupled through a ratchet freewheel designated in general by 27. The ratchet freewheel 27 on rotation of the driver sleeve 9 in the cycle driving direction entrains the hub sleeve 7 and otherwise permits a relative rotation of the hub sleeve 7 in the cycle driving direction of the driver sleeve 9. The ratchet freewheel 27 comprises a pawl-carrier ring 29 of sintered metal carrying aknurling (not shown further) on its external circumference. The pawl-carrier ring is pressed into a hollow-cylindrical extension piece 31 of the hub sleeve 7 which consists of a light metal alloy. The extension piece 31 and the pawl-carrier ring 29 overlap the toothing 11 of the driver sleeve 9. Two pairs of pawls 33, 35 are mounted on the pawl-carrier ring 29 pivotably about pivot axes parallel to the hub spindle 1 so that the pawls can engage under initial spring stress in the toothing 11 of the driver sleeve 9. The pawls 33 and 35 of each of the two pairs are here in each case arranged angularly offset through 180 degrees about the hub spindle 1, so that the forces transmitted by the pawls occur symmetrically and forces exerted unilaterally upon the bearings are avoided. In order to render this possible, the toothing 11 has an even number of teeth.

The teeth 13 of the toothing 11 are offset in relation to one another by equal angular intervals, related to their pawl action faces, in the circumferential direction of the driver sleeve 9. Furthermore the pawl pairs are offset in the circumferential direction of the hub sleeve in relation to one another so that the pairs are alternately in engagement with the toothing 11. The pivot axes of the pawls 33 for this purpose are offset in angle in relation to the pivot axes of the pawls 35 by an odd-numbered multiple of the angular interval of two adjacent teeth 13. In this way the idle motion of the freewheel drive hub in the transition from the freewheeling function to the driving function is substantially reduced. This is advantageous especially when the toothing 11 provided for the se curing of the chain wheels 15 is utilised at the same time as pawl toothing of the ratchet freewheel 27, since such toothings have relatively low numbers of teeth, here eight teeth.

As may best be seen from Figure 3, the pawls 33, 35 are mounted without bolts in pockets 37 of cylinder-segment form. The pivot axis is designated by 39 in Figure 3. On the side opposite, in the circumferential direction of the hub seleve 7, to the engagement end 41 of each pawl there is formed on each of the pawls 33, 35 a cam face 43 on which a spring ring 45 arranged concentrically with the hub spindle 1 rests and initially stresses the engagement end 41 into the toothing 11. As Figure 1 shows, the spring ring 45 is seated in a radial slot 47 of each pawl 33, 35. The pawls 33, 35 themselves are fixed by the spring ring 45 in the axial direction on the one hand by a stop shoulder 49 of the hub sleeve 7 and on the other by ribs 51 protruding radially inwardly from the pawl-carrier ring 29. The spring ring 45 is furthermore secured with an angled-off portion 53 in a slot 55 of the ribs 51 against twisting.

Figure 4 shows a variant of the freewheel drive hub in which a ratchet freewheel 61 corresponding to the ratchet freewheel 27 comprises pawls 65 mounted pivotably on a driver sleeve 63 and resiliently initially stressed radially outwards into a toothing 67 of a hub sleeve 69. In this case the pawls 65 axe pivotable about pivot axes parallel to the axis 71 of rotation of the driver sleeve 63 and of the hub sleeve 69. Several pawl groups (not shown further), especially pawl pairs, are provided which in conformity with the pawls 33, 35 are offset in the circumferential direction of the driver sleeve 63 so that the pawl groups engage alternately in the toothing 67.

Figure 5 shows a further example of embodiment in which at least two groups, especially two pairs, of pawls 77 are mounted pivotably about pivot axes extending radially of the rotation axis 73 on a hub sleeve rotatable about the rotation axis 73. The pawls 77 engage under resilient initial stress in a ratchet toothing 81 provided on the end of a driver sleeve 79 axially adjacent to the hub sleeve 75. The driver sleeve 79 is likewise rotatable about the rotation axis 73. Alternatively the pawls 77 can also be mounted on the driver sleeve 79 while the ratchet toothing 81 is provided on the hub sleeve 75.

Figure 6 shows diagrammatically a variant of the cycle freewheel drive hub according to Figures 1 to 3, which can also be used with the examples of embodiment according to

Figures 4 and 5. The toothing 87 provided in Figure 6 on the drive member 85 of the cycle drive hub comprises an odd number of teeth 89 arranged at equal angular intervals from one another. Two pairs of pawls 93 and 95 are mounted on a hub sleeve 91 for pivoting about pivot axes parallel to the axis 97 of rotation of the drive member 85 and of the hub sleeve 91. The pawls 93 ana 95 of each pair are offset in relation to one another about the rotation axis 97 by 180 degrees plus (or minus) half the angular interval, designated by A in Figure 6, between adjacent teeth. Moreover the two pawl pairs are offset in relation to one another in the circumferential direction of the hub sleeve 91 so that the pairs are alternately in engagement with the toothing 87. The pivot axes of the pawls 93 of the one pair are again offset in angle in relation to the pivot axes of the pawls 95 of the other pair substantially by an odd-numbered multiple of the angular distance of two adjacent teeth 89 from one another, in order to reduce the idle motion of the drive hub.

In all forms of embodiment the pawls can be mounted in separate pawl-carrier rings. If pockets are necessary for boltless mounting they can however also be formed directly into the hub sleeve or the driver sleeve as the case may be. The invention is not limited to ratchet freewheels in which the toothing provided for the mounting of chain wheels on a driver sleeve is utilised. Additional ratchet toothings can also be provided. The invention is further not limited to cycle drive hubs. By way of example the ratchet drive arrangement in accordance with the invention can also be used in manually actuatable crank drive systems.

CLAIMS

1. Ratchet drive arrangement, especially for cycle freewheel drive hubs, comprising

a) two rotation units rotatable either with one another or in relation to one another about a common axis of rotation;

b) a ratchet toothing having a plurality of teeth arranged at equal angular intervals from one another on a circle enclosing the axis of rotation, on a first one of the two rotation units;

c) a plurality of pawls offset in angle in relation to one another about the rotation axis and mounted pivotably on a second one of the two rotation units for engagement in the ratchet toothing which block the two rotation units against a relative rotation in a first direction and liberate them for a relative rotation in an opposite second direction; and

d) a spring device which resiliently initially stresses the pawls in the direction of their engagement in the ratchet toothing characterised in that at least two pawls are provided the angular interval of which is unequal to an integral multiple of the angular interval of the teeth of the ratchet toothing.

2. Ratchet drive arrangement according to Claim 1, characterised in that the pawls are arranged in at least two groups, the pawls of each group being at constant angular distance from one another and being arranged, in relation to the pawls of other groups, offset by an angular distance unequal to an integral multiple of the angular interval of the teeth of the ratchet toothing.

3. Ratchet drive arrangement according to Claim 2, characterised in that the ratchet toothing comprises an even number of teeth and in that the pawls are arranged by pairs and the pawls of each pair are offset in relation to one another by 180 degrees.

4. Ratchet drive engagement according to Claim 2, characterised in that the ratchet toothing has an odd number of teeth and in that the pawls are arranged by pairs and the pawls of each pair are offset in relation to one another by 180 degrees plus or minus half the angular distance (A) of the teeth from one another.

5. Ratchet drive arrangement according to Claim 4, charcterised in that the pawls of each pair are offset in angle in relation to the pawls of other pairs by approximately an odd-numbered multiple of half the angular interval of the teeth of the ratchet toothing.

6. Ratchet drive arrangement according to one of Claims 1 to 5, characterised in that the ratchet toothing is provided on a peripheral surface of a substantially cylindrical portion of the first rotation unit and in that the pawls are pivotable about axes extending parallel to the rotation axis of the rotation units.

7. Ratchet drive arrangement according to Claim 6, characterised in that the first rotation unit is formed as a drive member rotatably mounted on a hub spindle of a cycle freewheel drive hub, in that the second rotation unit is formed as a hub sleeve provided with spoke flanges and rotatably mounted on the hub spindle in that the ratchet toothing is formed by end regions of an external peripheral toothing of the drive member formed by axial grooves and intended for the rotation-fast retention of at least one chain wheel in that the pawls are guided pivotably about a pivot axis parallel to the hub spindle and defined by the bearing pocket in bearing pockets of the hub sleeve or of a ring held fast in the hub sleeve in that the pawls seen in the circumferential direction of the hub sleeve comprise on one side a pawl part for engagement in the ratchet toothing and on the other side a cam face protruding radially of the hub spindle and in that a spring ring concentrically enclosing the hub spindle and common to all pawls initially stresses the cam faces radially outwards.

8. Ratchet drive arrangement according to any one of Claims 1 to 5, characterised in that the ratchet toothing is arranged on an axial end face of the first rotation unit and in

that the pawls are pivotable about axes extending radially of the rotation axis of the rotation units.

9. Ratchet drive arrangement substantially as described with reference to the Figures 1 to 3, 4, 5 or 6 of the accompanying drawings.

Printed in the United Kingdom for
Her Majesty's Stationery Office, Dd 8818935, 1985, 4235.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.